

**Precise Measurements of Liquid and Gaseous PVT Properties near Saturation and
Assessment of Thermodynamic Behavior in the Gaseous Phase for
Difluoromethane (R32) and Pentafluoroethane (R125)**

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Existing thermodynamic equations of state (EOS) for hydrofluorocarbons (HFCs) are believed to be highly accurate compared with the uncertainties of experimental data. Three years ago Narukawa et al. in our group pointed out that there is a large difference (more than 5 %) in the worst case among the specific heat values at low temperatures and in the region near saturation derived from various existing EOS including an International EOS recommended by the International Energy Agency (IEA). They also pointed out the possibility that the third virial coefficient affects the calculation of thermodynamic properties such as C_p and C_v values especially near the saturation boundary.

We have measured PVT properties in both the liquid and gaseous phases including data near saturation and the vapor pressures for difluoromethane (R32) and pentafluoroethane (R125) by means of our PVT-property measuring apparatus equipped with two single-sinker densitometers developed by Wagner et al. In the case of R32 as an example, the uncertainty of the density measurements was estimated to be not greater than $0.023 \text{ kg}\cdot\text{m}^{-3}$ for the gaseous phase and $0.22 \text{ kg}\cdot\text{m}^{-3}$ for the liquid phase. The sample purity of R32 was 99.99 mass%.

On the basis of our measurements, we derived a vapor-pressure equation, a vapor-density equation, and a truncated virial EOS for each refrigerant. The third virial coefficient is carefully assessed by comparison with the predicted values from an intermolecular potential model on the basis of speed-of-sound measurements. The present virial equation can represent thermodynamic-property values in the wide gaseous phase including low temperatures and near or at saturation even where no experimental data are available in the gaseous phase.